

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/US2007/019669

International filing date (day/month/year)
11.09.2007

Priority date (day/month/year)
11.09.2006

International Patent Classification (IPC) or both national classification and IPC
INV. H01L21/20

Applicant
PRESIDENT AND FELLOWS OF HARVARD COLLEGE

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



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Date of completion of
this opinion

see form
PCT/ISA/210

Authorized Officer

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US2007/019669

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - ☒ the international application in the language in which it was filed
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).
2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - ☐ a sequence listing
 - ☐ table(s) related to the sequence listing
 - b. format of material:
 - ☐ on paper
 - ☐ in electronic form
 - c. time of filing/furnishing:
 - ☐ contained in the international application as filed.
 - ☐ filed together with the international application in electronic form.
 - ☐ furnished subsequently to this Authority for the purposes of search.
4. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US2007/019669

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of

☐ the entire international application

☒ claims Nos. 14-55

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international search (*specify*):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed (*specify*):

☒ no international search report has been established for the whole application or for said claims Nos. 14-55

☐ a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

☐ furnish a sequence listing on paper complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in a form and manner acceptable to it.

☐ furnish a sequence listing in electronic form complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in a form and manner acceptable to it.

☐ pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rules 13ter.1(a) or (b).

☐ a meaningful opinion could not be formed without the tables related to the sequence listings; the applicant did not, within the prescribed time limit, furnish such tables in electronic form complying with the technical requirements provided for in Annex C-bis of the Administrative Instructions, and such tables were not available to the International Searching Authority in a form and manner acceptable to it.

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in electronic form only, do not comply with the technical requirements provided for in Annex C-bis of the Administrative Instructions.

☐ See Supplemental Box for further details

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US2007/019669

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees, the applicant has, within the applicable time limit:
- ☐ paid additional fees
 - ☐ paid additional fees under protest and, where applicable, the protest fee
 - ☐ paid additional fees under protest but the applicable protest fee was not paid
 - ☒ not paid additional fees
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with
 - ☒ not complied with for the following reasons:
see separate sheet
4. Consequently, this report has been established in respect of the following parts of the international application:
- ☐ all parts.
 - ☒ the parts relating to claims Nos. 1-13

Box No. V Reasoned statement under Rule 43b/s.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	<u>1-13</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	<u>1-13</u>
	No: Claims	
Industrial applicability (IA)	Yes: Claims	<u>1-13</u>
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item IV.

The separate inventions/groups of inventions are:

- Claims 1-13: A method of producing a branched nanoscale wire characterised by etching the wire to produce an H-terminated surface and exposing this surface to a solution comprising a metal ion to form a nanoparticle from which the branch is grown.
- Claims 14-24: A method of producing a branched nanoscale wire (and corresponding article) wherein the wire has a core and a shell by immobilising a positively-charged entity to the shell and exposing it to a negatively-charged nanoparticle which is adsorbed thereby. The branch is grown from the nanoparticle.
- Claims 25-31: A method of producing a branched nanoscale wire characterised by depositing a nanoparticle on the wire and growing a metal segment therefrom.
- Claims 32-39: An article having a branched nanoscale wire having two segments which are of different composition.
- Claims 40-46: A method of producing a branched nanoscale wire characterised by depositing a nanoparticle on the wire, exposing it to a solution containing an ion, causing the ion to deposit on the nanoparticle, thereby causing growth of a segment.
- Claims 47-54: An article having a branched nanoscale wire of which at least one branch comprises a core and a shell, the core and the shell having different compositions.
- Claim 55: An article having a branched nanoscale wire able to emit light.

They are not so linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:

The features which are common to all independent claims are the following:

- a nanoscale wire or its provision; and
- a branch or segment extending from the nanoscale wire or the corresponding growth.

These common features are known in the state of the art, see e.g.

The additional features of the above identified groups of claims are not so linked as to form a single general inventive concept as required by Rule 13.1 PCT for the following reasons:

The first and second groups of claims define two rather specific methods of forming nanoparticles on a semiconductor nanoscale wire. However, these two methods are also not linked as required by Rule 13.1 because they are not technically related with each other. In particular, according to claim 1 the wire is etched to produce an H-terminated surface which in turn reduces a metal ion exposed to this surface. Thereby the metal ion deposits on the surface and forms a nanoparticle from which the branch is grown. In contrast thereto, according to claim 14 the wire has a semiconductor core and a semiconductor oxide shell, to which shell a positively-charged entity is immobilised. This positively-charged entity adsorbs a negatively-charged nanoparticle from which the branch is then grown.

The other groups of claims are not concerned with specific methods of forming a nanoparticle on a nanoscale wire but rather with certain materials of the branched nanoscale wires (see the third, fourth and sixth groups of claims), or with a specific method of treating the nanoparticle with a solution before the branch is grown (see fifth group of claims), or with an intended desired property of the branched nanoscale wire (see seventh group of claims).

In this regard, it is pointed out that the fifth group of claims is not technically related to any of the other groups of claims since the aftertreatment of a deposited nanoparticle typically solves different kinds of problems than those which arise during the deposition of these nanoparticles. Furthermore, these treatments are not related to the specific materials which should be used according to the third, fourth and sixth group of claims.

Concerning the third, fourth and sixth groups of claims it is submitted that specifying the material, namely a metal, of the branches is not related to specifying that the branch and the nanoscale wire should be of different materials, which in turn is not related to specifying that the branched nanoscale wire should have core-shell structure wherein the core and the shell are of different materials.

And last but not least none of the first to sixth group of claims is technically related to any particular use of a branched nanoscale wire, such as light emission.

Re Item V.

- 1 Reference is made to the following documents:

D1: NANO LETTERS, vol. 4, no. 5, May 2004, pages 871-874, XP009094914
D2: MATERIALS SCIENCE AND ENGINEERING C, vol. 26, no. 5-7, July 2006,
pages 800-804, XP005461070
D3: US 2004/095658 A1

- 2 None of these documents discloses the specific method of claim 1 for forming the nanoparticles on the nanoscale wires from which nanoparticles the segments or branches are grown. The steps of etching the nanoscale wire to produce an H-terminated surface and exposing this surface to a solution comprising a metal ion to form at least one nanoparticle on the wire is also not rendered obvious for the skilled person by these documents (Article 33(2)(3) PCT).
- 3 Claims 2-13 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Possible steps after receipt of the international search report (ISR) and written opinion of the International Searching Authority (WO-ISA)

General information

For all international applications filed on or after 01/01/2004 the competent ISA will establish an ISR. It is accompanied by the WO-ISA. Unlike the former written opinion of the IPEA (Rule 66.2 PCT), the WO-ISA is not meant to be responded to, but to be taken into consideration for further procedural steps. This document explains about the possibilities.

Amending claims under Art. 19 PCT

Within 2 months after the date of mailing of the ISR and the WO-ISA the applicant may file amended claims under Art. 19 PCT directly with the International Bureau of WIPO. The PCT reform of 2004 did not change this procedure. For further information please see Rule 46 PCT as well as form PCT/ISA/220 and the corresponding Notes to form PCT/ISA/220.

Filing a demand for international preliminary examination

In principle, the WO-ISA will be considered as the written opinion of the IPEA. This should, in many cases, make it unnecessary to file a demand for international preliminary examination. If the applicant nevertheless wishes to file a demand this must be done before expiry of 3 months after the date of mailing of the ISR/ WO-ISA or 22 months after priority date, whichever expires later (Rule 54bis PCT). Amendments under Art. 34 PCT can be filed with the IPEA as before, normally at the same time as filing the demand (Rule 66.1 (b) PCT).

If a demand for international preliminary examination is filed and no comments/amendments have been received the WO-ISA will be transformed by the IPEA into an IPRP (International Preliminary Report on Patentability) which would merely reflect the content of the WO-ISA. The demand can still be withdrawn (Art. 37 PCT).

Filing informal comments

After receipt of the ISR/WO-ISA the applicant may file informal comments on the WO-ISA directly with the International Bureau of WIPO. These will be communicated to the designated Offices together with the IPRP (International Preliminary Report on Patentability) at 30 months from the priority date. Please also refer to the next box.

End of the international phase

At the end of the international phase the International Bureau of WIPO will transform the WO-ISA or, if a demand was filed, the written opinion of the IPEA into the IPRP, which will then be transmitted together with possible informal comments to the designated Offices. The IPRP replaces the former IPER (international preliminary examination report).

Relevant PCT Rules and more information

Rule 43 PCT, Rule 43bis PCT, Rule 44 PCT, Rule 44bis PCT, PCT Newsletter 12/2003, OJ 11/2003, OJ 12/2003